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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/791,597	03/02/2004	Brent Jerome Brunell	140228-1	3436

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GENERAL ELECTRIC COMPANY
GLOBAL RESEARCH
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NISKAYUNA, NY 12309

EXAMINER	
KIM, TAE JUN	
ART UNIT	**PAPER NUMBER**
3746	

DATE MAILED: 04/27/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/791,597	Applicant(s) BRUNELL ET AL.	
	Examiner Ted Kim	Art Unit 3746	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *01 March 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-11,15-30 and 34-38* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-11, 15-30, 34-38* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-11, 15-30, 34-38 are rejected under 35 U.S.C. 103(a) as being obvious over Brunell et al (6,823,675) or Brunell (6,823,253), in view of each other or singly, and further in view of Ward et al (6,208,914). Brunell et al '675 teach a system for controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: a state estimator (see Fig. 5; col. 8, lines 48+) adapted to estimate a state of said engine by estimating one or more unmeasured or unsensed parameters using data from said sensors of said engine for one or more measured or sensed parameters, said estimator including a model (see Fig. 12) of said engine; and a control module adapted to generate commands for said actuators based on said state, said control module including an optimization algorithm (see optimizer in Fig. 12 and col. 9, lines 45+) for determining said commands; a method of controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: receiving data from said sensors of said engine for one or more measured or sensed parameters;

estimating a state of said engine by estimating one or more unmeasured or unsensed parameters using the data from said sensors and a predictive model of said engine; and generating commands for said actuators based on said state using an optimization algorithm; and transmitting said commands to said engine; wherein said step of generating commands includes simulating said engine in a model; said optimization algorithm is a quadratic programming algorithm (col. 13, lines 20+) adapted to optimize an objective function under a set of constraints; wherein said objective function is based on at least one of said unmeasured or unsensed parameters; wherein optimization algorithm uses a control horizon to optimize said objective function (col. 9, lines 45+); wherein said control horizon is finite; wherein at least one of said constraints is based on at least one of said unmeasured or unsensed parameters; wherein said predictive model is a simplified real-time model (col. 9, lines 5+); wherein said simplified real-time model is a non-iterating, analytic model; wherein said simplified real-time model is a non-linear model which can be linearized. The Brunell '675 reference teaches the filters but not specifically the EKF. Brunell '253 teach the EKF is a well known filter. It would have been obvious to one of ordinary skill in the art to employ the EKF as a well known filter for the control system.

Brunell '253 teaches a system for controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: a state estimator (EKF) adapted to estimate a state of said engine by estimating one or more unmeasured or unsensed parameters using data from said

sensors of said engine for one or more measured or sensed parameters, said estimator including a model of said engine; and a control module adapted to generate commands for said actuators based on said state, said control module including an optimization algorithm (SRTM) for determining said commands; a method of controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: receiving data from said sensors of said engine for one or more measured or sensed parameters; estimating a state of said engine by estimating one or more unmeasured or unsensed parameters using the data from said sensors and a predictive model of said engine; and generating commands for said actuators based on said state using an optimization algorithm; and transmitting said commands to said engine; wherein said step of generating commands includes simulating said engine in a model; wherein said state estimator/step of estimating uses an Extended Kalman Filter (EKF); wherein said Extended Kalman Filter is adapted to correct a mismatch between said model and said engine; wherein said predictive model is a simplified real-time model; wherein said simplified real-time model is a non-iterating, analytic model; wherein said simplified real-time model is a non-linear model which can be linearized (col. 8, lines 13+); wherein said optimization algorithm is a quadratic programming algorithm (see equations 2, 3 which are quadratic) adapted to optimize an objective function under a set of constraints; wherein said objective function is based on at least one of said unmeasured or unsensed parameters; wherein optimization algorithm uses a control horizon to optimize said objective function; wherein said control horizon is

finite; wherein at least one of said constraints is based on at least one of said unmeasured or unsensed parameters.

The Brunell references teaching a finite horizon algorithm and not an infinite horizon. Ward et al teach an infinite horizon control algorithm with infinite horizon tracking error (col. 7, lines 6+) as being an equivalent or alternative technique to using a finite horizon control algorithm. It would have been obvious to one of ordinary skill in the art to employ the infinite horizon control algorithm with infinite horizon tracking error, as an equivalent technique.

The applied reference has a common inventor with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the

reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(l)(1) and § 706.02(l)(2).

3. Claims 1-11, 15-30, 34-38 are rejected under 35 U.S.C. 103(a) as being unpatentable over Desai et al (6,729,139) in view of Ward et al (6,208,914). Desai et al teach a system for controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: a state estimator 54 adapted to estimate a state of said engine by estimating one or more unmeasured or unsensed parameters using data from said sensors of said engine for one or more measured or sensed parameters, said estimator including a model of said engine; and a control module 56 adapted to generate commands for said actuators based on said state, said control module including an optimization algorithm 56 for determining said commands; a method of controlling a gas turbine engine, said engine having sensors to detect one or more parameters and actuators adapted to respond to commands, comprising: receiving data from said sensors of said engine for one or more measured or sensed parameters; estimating a state of said engine by estimating one or more unmeasured or unsensed parameters using the data from said sensors and a predictive model of said engine; and generating commands for said actuators based on said state using an optimization algorithm; and transmitting said commands to said engine; wherein said step of generating commands includes simulating said engine in a model; wherein said state estimator/step of estimating uses an Extended Kalman Filter; wherein said Extended Kalman Filter 54 is adapted to correct a mismatch between said model and said

engine; wherein said predictive model is a simplified real-time model; wherein said simplified real-time model is a non-iterating, analytic model; wherein said simplified real-time model is a non-linear model which can be linearized; wherein said optimization algorithm is a quadratic programming algorithm 56 adapted to optimize an objective function under a set of constraints; wherein said objective function is based on at least one of said unmeasured or unsensed parameters. Desai does not teach the horizon based control algorithm. Ward et al teach an infinite horizon control algorithm with infinite horizon tracking error (col. 7, lines 6+) as well as finite horizon control algorithms are old and well known in the art for model predictive systems. It would have been obvious to one of ordinary skill in the art to employ either the infinite horizon control algorithm with infinite horizon tracking error (col. 7, lines 6+) or the finite horizon control algorithms as old and well known in the art for model predictive systems.

Response to Arguments

4. Applicant's arguments filed 03/01/2006 have been fully considered and amend around the 102 rejections but they are not persuasive with respect to the 103 rejections.

5. Applicant's central argument is that Brunell teaches a finite control horizon and not an infinite control horizon, which requires more processing power. However, this argument is not persuasive as Ward et al (6,208,914) clearly teach one of ordinary skill in the art using an infinite control horizon and finite control horizon are equivalent or alternative techniques used in the art (col. 7, lines 6+). Hence, one of ordinary skill in the art would be taught to use the infinite control horizon technique, regardless of whether it

requires more processing power. Hence, applicant's arguments do not take into account the rejections using Brunell et al (6,823,675) or Brunell (6,823,253), in view of each other or singly, and further in view of Ward et al (6,208,914), in which the equivalence was specifically addressed.

6. Applicant's arguments regarding Desai in view of Ward et al are not persuasive as the use of Ricatta equations by Ward does not render the claims unobvious over the art of record. Applicant relies on limitations that are not claimed, in particular the subject matter of paragraph [0023] from the specification. Hence, it is clear to the limited extent that the claims recite the optimization algorithm and model, the Desai and Ward combination would fairly teach the claim limitations.

7. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Contact Information

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Ted Kim whose telephone number is 571-272-4829. The Examiner can be reached on regular business hours before 5:00 pm, Monday to Thursday and every other Friday.

The fax numbers for the organization where this application is assigned are 571-273-8300 for Regular faxes and 571-273-8300 for After Final faxes.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Timothy Thorpe, can be reached at 571-272-4444.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist of Technology Center 3700, whose telephone number is 703-308-0861. General inquiries can also be directed to the Patents Assistance Center whose telephone number is 800-786-9199. Furthermore, a variety of online resources are available at http://www.uspto.gov/main/patents.htm

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